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METHOD AND APPARATUS FOR STRIP-COATING A METALLIC STRIP-SHAPED SUBSTRATE WITH A PLASTIC BAND AND STRIP THUS OBTAINED

The invention relates to a method for strip-coating a metallic strip-shaped substrate with a thin band of plastic, an apparatus for carrying out the method as well as to the coated strip obtained with the method.

There are at least two methods known for manufacturing a coated product comprising a metal substrate and a plastic layer adhering to it, namely film-laminating and extrusion-coating.

In the case of film-laminating, a finished plastic film is rolled off and applied onto the metal substrate.

In the case of extrusion-coating a sheet of plastic is applied onto the metal substrate directly or virtually directly from an extruder.

In the case of the first method a roll of finished film is taken as starting material. A problem in making a roll of film is rolling it up. The film tends to stick to itself so that the windings cling to each other. Because in its rolled up state the film shrinks somewhat, the roll has to be rolled up loosely to enable it to be controlled once again. Inevitable stresses in the film then easily cause edge build-up, the roll becomes unround, and the film displays spacing tracks when being rolled off. Among other things this makes the film incapable of being rolled off without difficulty at a sufficiently high speed; if this does succeed then there remains the problem that at higher rolling off speeds electrostatic discharge symptoms need to be reckoned with. To avoid such difficulties additives are added to for example household foils; in the case of film-lamination this solution offers no

remedy because the additives unacceptably reduce the capacity to adhere to the metal substrate.

On the face of it extrusion-coating would therefore seem an interesting alternative, and so it is for a small number of applications, namely those whereby the plastic involved has the correct adhesion properties in molten state. When this is no longer the case, or not adequately so, and molecules need to be incorporated in the plastic to migrate to the surface in order to accomplish adhesion, in the case of extrusion-coating the problems occur, at least where a high coating speed is desired. This is because adhesion groups only migrate fast enough, i.e. within tenths of a second, if a sufficiently high temperature can be maintained during the coating. This is only possible when coating onto one side of the substrate. The required high temperature then also makes it impossible subsequently to coat the other side because the previously applied coating becomes unacceptably damaged on the second exposure to the high temperature. Even non-subsequent but simultaneous two-sided extrusion-coating is no solution because in the case of extrusion-coating the slightest deviation in substrate thickness and the slightest disturbance in the process would cause unstable process operation and consequently coating differences and inhomogeneities on each side.

The problems surrounding the procedures outlined are resolved or at least substantially diminished if worked in accordance with the invention.

The method in accordance with the invention is characterised in that it comprises in combination the stages

(i) in-situ casting of a plastic band;

(ii) leading the plastic band around a cooling roll;

(iii) leading away the plastic band until the plastic band production is underway and

stabilised;

(iv) bringing the plastic band and the substrate up to speed and heating the substrate to a temperature of the substrate close to the softening temperature of the part of the plastic band facing the substrate;

(v) pressing the plastic band onto the substrate and where applicable breaking off the plastic band and stopping it being led away;

(vi) coating the substrate with the plastic band at high speed.

This achieves the effect of enabling a considerably thinner plastic layer to be applied onto metal strip in a controlled and economically viable manner.

The invention is also embodied in an apparatus for the continuous band-coating of a metal substrate with a layer of plastic.

Finally the invention is further embodied in a band-coated packaging steel.

The invention will now be further illustrated by reference to the drawing comprising Figures 1, 2 and 3 each of which show a possible line drawing for coating in accordance with the invention, and several non-limitative examples with references to the Figures.

Example 1

A ECCS substrate (1) (also known as TFS) with a thickness of 0.20 mm. This substrate is heated to a temperature of 230 °C by means of heating means (2), for example comprising heated guide rolls and/or on the basis of induction, hot air or otherwise. A plastic band (3) such as a PET plastic band is produced by molten PET via nozzle (4), (4a) on each side of substrate (1) on an internally water-cooled guide roll (5), (5a). The cooled PET band (3) is then conveyed to the rubber coated contact roll (6). As it travels it is possible to monitor the thickness, colour and band tension and to trim to the correct width. The thickness of the two bands (3) is between 3 and 100 μm. Prior to commencement of

coating the contact rolls (6) do not touch substrate (1), and the two bands are conveyed off, for example rolled up on winders (7).

In order to begin coating, contact rolls (6) are closed, i.e. moved towards substrate (1).

PET bands (3) adhere to substrate (1) and almost simultaneously the pieces of band (3) between contact roll (6) and winder (7) are cut through. The rubber of rolls (6) is cooled externally, for example by metal cooling roll (8), or by an air-blade on the rubber surface. The coated strip is then subjected to a brief extra heat treatment to 260 °C in order to optimise adhesion. A good product results, particularly suitable for example for the covers of three-part cans.

Example 2

As in Example 1 but now on the one side of substrate (1) the plastic flowing from nozzle (4a) is a two-layer polypropylene, whereby one of the layers, the adhesion layer, is maleic acid hydride modified polypropylene; on the other side of the substrate a PET band is manufactured and supplied via nozzle (4) and cooling roll (5). In this case the preheating temperature of substrate (1) is 200 °C. The thickness of the two bands is between 3 and 100 μm. During the initial contact of the two-layer band with the substrate at 200 °C, a temperature above the melting temperature of polypropylene, there is already some adhesion onto substrate (1), while the polypropylene top layer neither sticks to or is damaged by the rubber of contact roll (6) that has a temperature of approx. 90 °C. This adhesion to substrate (1) attains its maximum after approx. 1 second. The coated strip is then subjected to a brief extra heat treatment, for example to 260 °C, in order to optimise the adhesion of both PET and modified PP. A product results, for example particularly suitable for beer bottle crown closures.

Example 3

As in example 1 but now both plastic bands are two-layer polypropylene. Substrate (1) is 0.10 mm thick ECCS and is heated to a temperature of 230 °C. Now a product results with a PP layer on both sides. The higher temperature than in example 2 is necessary because of the low heat content of thin substrate. The product is particularly suitable for example for animal food packaging.

Figures 1, 2 and 3 show different line drawings in accordance with the invention of coating a metal substrate with an in-line manufactured plastic band. Fig. 2 shows a vacuum chamber (20), an electrostatic edge limiter (9), an air-blade (10) for cooling, a thickness gauge (11), an edging knife (12), a cutting waste extractor installation (13), a temperature gauge (14) and a furnace (15) for heating the coated strip.

It is possible to stretch the plastic band at a temperature above the glazing temperature and below the softening temperature of the plastic; in the case of uni-axial stretching an elongation of up to 400% is conceivable. If desired it is possible to provide the plastic band with openings.

To the expert it will be clear that the invention can be applied for single-side or two-side coating of a metallic substrate with on each side the same plastic, or a different plastic for example PET or polypropylene or on one side polypropylene and on the other side PET.